30 Track
games for young children

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explain how the 30 Track, a metre-long device with 30 blocks that rotate to reveal the corresponding numerals, has the potential to facilitate the learning of number and counting skills in young children.

How far should young children be taught to count?

Whenever teachers of young children get together there will be differences of opinion about how far children should be taught to count. Some will argue that the focus should be on small numbers to 9, building up the notion of what, say, the name 5 means, what it looks like, and how it can be represented. Others argue that with ice blocks retailing at $1.35 each, it is more important for children to be exposed to two and three-digit numbers so that they can figure out how these bigger numbers operate. Development of number knowledge is further inhibited by the absence of the 1 and 2-cent coins that used to be countable items. We know that for many children, counting forms the basis for early numerical problem solving, but there is perhaps a need for balanced, simultaneous development of one and two-digit numbers, so that children learn small numerosity at the same time as beginning to appreciate how the larger number system works.

Why 30?
Syllabus rationale for the 30 Track

Reference to the curriculum websites shows that these differences of opinion are reflected to some extent in syllabus documents across the nation. The new Mathematics K–6 Syllabus 2002 for NSW schools, in a significant departure from previous content, has stipulated (p. 41) that students at Early Stage 1 will count to 30, order, read and represent numbers in the range 0–20.

The Victorian Framework Learning Outcomes for Level 1 require students to count, compare and order collections of at least twenty objects; model numbers up to at least 10 and use counting strategies to find and verbalise relationships between small numbers; recognise and write numerals from 1 to 10 and use them to record simple addition and subtraction facts and doubles; use knowledge of numbers, counting and addition and subtraction relationships to explore and describe simple, everyday numerical situations including the use of money; and to use materials and a calculator to recognise, generate and represent simple number patterns.

Learning Outcomes from the July 2003 draft of the Queensland Mathematics Syllabus at Foundation Level are not prescriptive on the magnitude of numbers which students should encounter, referring to 'a developing notion of counting and an awareness of number and money. Number names are becoming more meaningful.' At Level 1, the document refers to 'a developing sense of number by knowing number names and counting in sequence'. Students, it says, 'recognise, compare, order and represent small whole numbers'.

Western Australian documents are similarly non-specific as regards the magnitude of numbers at early childhood level. Children at the end of Year 1 would be expected to read, write, and say 'small whole numbers', say how many things there are, make collections of a given size, and describe order. Again, in Outcome 8, 'students can use mental imagery and mental counting strategies to add and subtract small numbers such as three and four'.

In the Northern Rivers Region of New South Wales, some forty K/1 teachers have been experimenting with the '30 Track' — a metre-long device which sits on the teacher's lap, and

Figure 1. The 30 Track.

which has 30 blocks which rotate to reveal the corresponding numerals. This article suggests that the 30 Track has the potential to facilitate the learning of number and counting skill by representing the numbers to 30 in an easily accessible, countable format. Early results indicate that when numerals and names are presented simultaneously there may be a mutually reinforcing effect that helps young children to use the *numeral* system to decode the two-digit number naming grammar, perhaps assisting children to 'skim over' those awkward teen numbers.

Learning the recitation

Of course children come to school with quite varied abilities in recitation counting. An isolated few can recite to 100, some can go to 10, while others have difficulty maintaining stable recitation below that. With children grouped on the mat, the first exposure to the '30 Track' consists of the teacher 'flipping' all the thirty blocks over and back again in one motion so that the numerals to 30 are exposed for one second only. Children are then asked what they saw:

'Numbers.'

'And what was this one?' asks the teacher, pointing to the hidden 1. Instant validation comes when the teacher flips the 1 block over so that everyone can see. 'And who was looking up this end?' asks the teacher, pointing to the hidden 30. 'I'll do it again for you.'

This time, as the teacher flips all blocks over, the students sit with eyes glued to the other end. Some know the numeral to be 30, but most do not. The teacher can quickly validate by showing them. The next step is to lead the children to count to thirty by flipping the blocks over one at a time. There will be enough children who know the recitation to drive the rest. This simultaneous presentation of numeral with name develops co-ordination of the forward number

word sequence (FNWS) with the turnover of each block; the 'click' of the block as it turns over to reveal the numeral being a useful additional stimulus. At all times, teachers must be prepared to step back to an easier level if the children hesitate.

Following on from this, the recitation sequence can be developed by 'jumping in' to the sequence at any point. The teacher exposes the 3 and asks: 'What is this? What comes next? And next? And next? Keep going.'

Then start at 10: 'What is this? What comes next? And next? And next? Keep going.'

Then try 20, then 6, then 16 (chosen because unlike 'thirteen' and 'fifteen', there is no linguistic transformation on 'six'), then 19, then 21, 25. Practice until the students are forward fluent from any point. 'This is the six; who can tell me what the next block will be? Was she right? Let's see…'

If difficulties are apparent, practice 'nexts', 'betweens', and 'befores'. For example, show 1: ask, 'What is this? What comes next? Check. Were you right?'.

Show 7 and ask, 'What is this? What comes next? Check. Were you right? How did you work it out?' Show 14: 'What is this? What comes next? Check. Were you right? Annie, please show me a block. What is it? What comes next? Check. Were you right?' Then move to 'betweens' and 'befores' until fluency develops. Show 5 and 7: 'What comes between these blocks?' Show 7: 'What comes before this one? Check. Were you right?' Lip movement may indicate the child counting up to seven. 'Come and show me the number before seven. Was he right?'

Mystery block

It is an easy matter to hold one block back with the thumb as the others are all flipped over at the same time. The teacher asks, 'Which block is stuck? Was she right?' Hold back the 7 and the 24 as the others are flipped over and ask, 'Which blocks are stuck? How did you know?'

Try asking, 'Who can show me a number that starts with *tuh*? Show me another number that starts with *tuh*. Show me a number that starts with *ssss*'. (Try '*nnnn*', but do not try '*ffff*' because you will most likely get the response '*Ffff*ree'.)

Now is a good time to also develop the *Backwards Number Word Sequence* (BNWS). Show the 10, then the 9, then the 8 etc., as the children recite the BNWS. They will probably want to say, 'Zero, blastoff!' but of course the 30 Track does not have a zero because at this level zero is not a counting number. Then show the 20, and get them to count down to 10 as blocks are flipped over. Then show the 30 and count down to 20. It is probably at this stage where reading numerals comes into play: the child sees the 9 in 29, and thinks 'twenty-nine', then sees the 8 in 28 and thinks 'twenty-eight'.

Counting figurative items (substitutes for observed unit items)

Next, we move on to counting figurative items which we might call 'clicks', based on the idea that each block makes a 'click' as it flips over.

The teacher says, 'Everybody close their eyes. I'm going to click some blocks over and you must tell me what number I'm up to on my 30 Track.' The teacher clicks over 1 and 2, and covers them with a hand. 'Eyes open. Who can tell me how far we are down the track?' There is instant validation for a correct response. Try again with 1, 2, 3, 4; then 1, 2, 3, 4, 5, 6 and larger numbers.

The teacher asks, 'Jamie, could you please stand behind me and hold up some fingers so that the class can see them? Now class, I want you to tell me to stop when I reach that number.' The teacher flips blocks until the class says 'Stop'.

Mental Magician

A child stands at the back of the room facing away from the track. The teacher says, 'I am going to click some blocks and I want you to tell me how far we are on our thirty track.' The teacher flips 1, 2, 3 and 4; the child responds 'Four'. The teacher asks the student, 'Look and check. Were you right?'.

Finger patterns can also be developed for use in later arithmetic. Choose a child to stand at the back of the room facing away from the track. The teacher says, 'I'm going to click some

blocks over and I want you to show me how many with your fingers'. The teacher clicks 1, 2, 3, 4, 5, 6, 7 and child shows a five and a two finger pattern. 'Was she right?'

As these 'counting all' skills develop, the *cardinal principle* is emerging in children's thinking. This monumental shift in thinking is represented by responses which no longer require a full count to answer the question, 'How many?' because the answer is the last number-name uttered. To introduce this idea, the teacher can show the 4 and ask, 'How many clicks would I make to get up to this number?'. The teacher validates by demonstrating. Next, the teacher might show the 6 and ask, 'How many claps would I make to get to this number? Would you do it for me, Alice?'. The teacher clicks 6 blocks as the child claps.

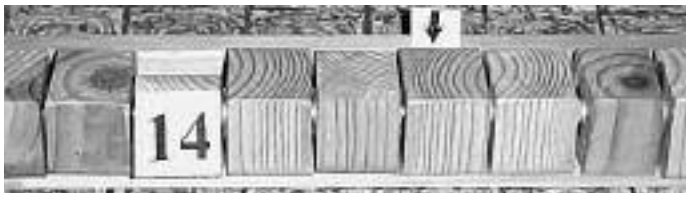
The teacher shows the 3 and asks, 'Tom, would you stand up this many times?'; showing the 4: 'Trinh, would you take this many steps?' Using the 30 Track we no longer have to show the numbers less than the last: 'Peter, would you clap hands three times?'; show the numeral 3. A child jumps 6 times, then clicks over the 6 block to show how many jumps. 'Everyone close their eyes.' The teacher turns over 7 blocks, making audible clicks, then puts some paper in front of the exposed blocks. 'Who can tell me how many clicks?' A child responds, 'Seven' and the teacher removes the paper from all except the 7 and asks the class, 'Was she right?'.

The beginnings of counting on

Counting on is an essential skill in learning addition, and we can introduce the notion effectively using the 30 Track. The teacher could show the 3, and point to the hidden 5, asking, 'If this is three, what is this one?'. Show the 7 and point to the hidden 9: 'If this is seven, what is this one?' Show the 4 and point to the hidden 9: 'If this is four, what is this one?'. In transition to the profound meaning shift that is *cardinality*, you will see children who need to construct the notion 'nine' by counting-all up to 9. In terms of this last exercise, you will see children's lips move as they point their nose to the first 3 blocks, counting 1 through 4, and then on to 9. We can provoke counting on, and hence cardinality, by covering the first 3 blocks, so that they have nothing to count.

Counting on activities

Teacher: What is this? [pointing to the 14]
Child: Fourteen.
Teacher: Well, [pointing to the 17] what's this one?



Magician

Select a child to be the 'magician' and to stand behind the teacher. The teacher says, 'I'm going to click some blocks and you have to tell me how far down the track we are.' The teacher flips the 1, 2 and 3, and then covers the 1, 2 and 3 with paper. The teacher asks, 'How far?' and then uncovers all and asks the child to check.

This could then be repeated with another child, but this time start from 3 and click some more blocks. The teacher clicks 4 more blocks and covers all except the 7. The child has to count on from 3 to get to 7. The next 'magician' then starts at 7.

Along the track means 'more', back the track means 'less'

The strength of the 30 Track appears to be that it presents a model of the number system that is consistent with young children's conception of number. They appear to know that number names start at 'one' and go on forever but may lack the knowledge of the number-naming grammar that generates those names; without that number-naming grammar knowledge, they cannot appreciate that the string is divided into groups of 10.

We can build on this conception by developing the idea of 'more' and 'less'. Using the 30 Track, the teacher asks, 'If I

show you the 8,' and flips the 8, 'who can tell me a number further along? Come and show. Daniel, would you stand behind me and hold up some fingers? I'm going to show the rest of the class a block and they must tell me whether my block is *more* than the number of fingers Daniel is holding up.'

Alternately, the teacher could say, 'Jonah, please write a number on the whiteboard. Now class,' as the 9 is flipped, 'is this number *more* than Jonah's? I'll show you a block, and I want you to tell me a number that is *more*. Come and show me. Give me a number that is less.' The teacher could home in even m ore by asking, 'Jordan, would you flip a block, but don't let me see it. Now, I'm going to try to guess Jordan's number, but you must help me by answering "Yes" or "No". Is Jordan's number *more than* 7?'

'Yes.'

'Is Jordan's number more than 10?' etc.

The composite unit of ten

It is often problematic to identify children's behaviour that is symptomatic of the construction of a ten composite. Certainly cardinality — the knowledge that a 'ten' consists of all the number names which come before it — appears to be essential. One of the strengths of the 30 Track is that it is a *linear* structure to 30, and this representation appears to be more consistent with a child's conception of numbers at this stage: that 'they go on forever'. For some children, teachers may like to point out that the dividers on the 30 Track segment the numbers into groups of 10, although it is probably too early to hope that the notion of a composite unit of 10 will develop from such exposure for most children. In this sense, the 30 Track linear model is a useful precursor for the 10 × 10 structures commercially available.

Let us conclude with some games to introduce addition, subtraction, patterns and algebra (which at primary level refers to patterns and generalisations about number).

Addition

Show the 7 and ask, 'Where would I be if I added 6 more (clicked 6 more)?' Show the 10: 'Where would I be if I flipped four more blocks? Let's check.'

Counting back

Expose the 8, then point to the covered 5 saying 'What's this?'. If a child counts up from 1 ('counting all'), obscure the beginning of the track to force them into counting back from 8.

The teacher may ask, 'What is this?' while pointing to the 17. If the child responds correctly, ask, 'Well, what's this one?' and point to the 'covered' 13. 'Were you right? Come and check.'

Subtraction

Show all blocks to 8 and ask, 'Where would I be if I took three blocks away?' Click the blocks over to reveal, 'We would be at 5'. Then show all blocks to 14 and ask, 'Where would I be if I took six blocks away? You do it for me to show you are right.' Show just the 8: 'Where would I be if I went back 3? 8, 7, 6 — we would be at 5.' Show 10: 'Where would I be if I went back six?'. Show 23: 'Where would I be if I went back eight?' etc.

Play *Magician* using subtraction. The teacher says, 'I need a magician. Angelo, I'm going to show you eight blocks,' and flips over the 1 to 8 blocks. 'Now stand behind me. I'm going to take some blocks away, and you must tell me where we are on our 30 Track.' The teacher flips 8, 7, and 6 blocks. 'Where are we Angelo?' Show all blocks to 20: 'Now I'm going to take ten away. Where will I be on our 30 Track?'

Tens pattern

The teacher says, 'Show me a number that ends in five. Show me another number that ends in five.' Show the 7: 'What number is ten more than this?'. Allow the students to count up 10 blocks and ask, 'How is this number (7) like this number (17)?'. Show the 23 and ask, 'What number is ten

less than this? How do you know?'. Show 4, 14, 24 pattern of ten and ask the children to find and discuss others that are similar.

Even numbers

Skip counting by 2. The teacher says, 'We are going to do this pattern: miss, click, miss, click, miss, click.' The children can continue the pattern by counting the misses quietly.

Multiples

To count using multiples of threes: 'Miss, miss, click, miss, miss, click,' etc. Fours: 'Miss, miss, miss click'. Fives, pair up: 'Miss-miss, miss-miss, click. Miss-miss, miss-miss, click'.

Counting numbers

Counting numbers themselves is indicative of the abstract stage of counting, and the 30 Track provides a useful platform to investigate which children can undertake this skill. Hide some blocks, say, 5, 6 and 7, with a cloth or piece of paper while exposing the 4 and the 8. Point to the 4 and 8 in turn and say, 'This is the four, and this is the eight. How many blocks are hidden?'. It is *not* 8 – 4 which is why we phrased the question as 'How many blocks are hidden?' You will see some children using their fingers to count: 'Five is one, six is two, seven is three. So, three.' Later, hide 2, 3, 4, 5, 6, 7 with a cloth while exposing the 1 and the 8, and say, 'This is the one and this is the eight. How many blocks are hidden?' Later, hide 23, 24, 25, 26, 27, 28, and 29 while exposing the 22 and the 30: 'This is twenty-two and this is thirty. How many blocks are hidden?' Remember that the aim is to prompt them to count number names: 'Twenty-three, that's one; twenty-four, that's two…'

Counting number names

The teacher asks, 'This one is ten, and this one is twenty one. How many names are hidden?'

The child (who may use fingers) responds, 'Eleven is one, twelve is two,' (silently thirteen, fourteen, fifteen, sixteen, seventeen, eighteen) 'nineteen is nine and twenty is ten: so, ten.'

Add patterns

The linear structure of the 30 Track lends itself to exploring repetitive patterns. Show the 4, then add 3, and 3, and 3, and 3; then ask, 'What is my next number?'. Even plus even, odd plus odd, even plus odd, odd plus even.

Heavy patterns for gifted or upper primary

Algebra at the primary level is patterns, expressed in terms of 'If I do this each time, I'll get this.' So, the teacher shows 1, 3, 7, 15 and says, 'What is our pattern? We are doubling and adding one.' Then show 3, 5, 9, 17 (double and minus one); show 1, 4, 13… 'What is our pattern?'

In summary, the 30 Track is a *linear* model that facilitates the simultaneous, mutually reinforcing development of written and linguistic representation schemes for numbers to 30 by presenting countable items (blocks) with corresponding numerals.

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